Table IV.—Slow Breaking of Iron Wire, ·036 inch in diameter, at various speeds. "Bright Annealed Wire."

Number of experiment.	Rate of adding weight.	Breaking weight in pounds.	Per cent. of elongation on original length.
1	1 lb. per 24 hours	47	6·92
2	½ " "	47	4·79
3	½ " "	46½	6·00

I have to acknowledge the very great assistance rendered to me in the carrying out of these experiments by Mr. Sinclair Couper, who has not only most faithfully carried out the work entrusted to his charge, but has in many cases originated and carried out experiments at various points of the inquiry.

XXII. "Note on the paper (read April 24)* 'A Summary of an Inquiry into the Function of Respiration at Various Altitudes on the Island and Peak of Teneriffe.'" By WILLIAM MARCET, M.D., F.R.S. Received June 16, 1879.

In the above-stated communication, after alluding to Dr. Rattray's observations† and remarking that I had formerly held the same views as he did, namely, that less carbonic acid was exhaled under increasing temperatures of the sun; I add, I am now compelled, however, to alter this view, and to conclude that more carbonic acid is formed in the body under a tropical or nearly tropical sun than under temperate latitudes.

Lest I should be considered as ascribing to the sun's heat a power which so far has not been acknowledged by physiologists, namely, that of increasing the formation of carbonic acid or the combustion in the body, I must beg to explain in a few words how the question now stands. I shall end by asking leave to suspend any opinion as to the cause of the increase of combustion in the body I observed to take place on the Island of Teneriffe, until more direct experiment has been brought to bear on the subject.

From trustworthy experiments by known authors, heat and light are found to act differently with respect to the formation of carbonic acid in the animal and human body; increased heat, as a rule, diminishes the production of this gas, and it is generated in excess under increased light.

* "Proc. Roy. Soc.," vol. xxviii, p. 498.

† "Proc. Roy. Soc.," 1870, 1871, 1873.

The experiments of Edward Smith,* show that more carbonic acid is expired by man in summer than in winter. Vierordt† finds that a change of temperature, equal to 10° F., alters the amount of carbonic acid expired by 0·0183 per cent., increasing it to that amount by a fall, and raising it by that figure through an increase. These observations were made under temperatures ranging between 38°·7 and 75°·7 F.

Letellier‡ in 1845, investigated the action of low and high temperatures on the production of carbonic acid in the animal body. Animals were made to breathe under a glass receiver during periods varying from half an hour to several hours. The results are stated in tables which show generally that at the temperature of 32° F., the carbon burnt is twice as great as at 86° F., while at the ordinary temperature intermediate figures are obtained, there being at times an increase and at others a falling off in the amount of carbonic acid formed. This applied equally to a canary bird, a dove, two mice, and a guinea-pig; there was, however, a peculiarity with respect to two of the guinea-pigs. Out of three experimented upon, No. 1 yielded at high and low temperatures 1·457 CO_2 and 3·006 CO_2 respectively, or nearly in the proportion of 1 to 2, while with guinea-pigs Nos. 2 and 3 the proportion of carbonic acid expired was 1 to 1·5 or 1·4, instead of 1 to 2. In these cases, however, both animals had been clearly very uncomfortable under the high temperature, and one died. The survivor's temperature had risen by 3° and that of the other by 5°·5. But the circumstance perhaps most worthy of notice, as Letellier expresses it, is that heat which the author finds under ordinary circumstances to reduce the formation of carbonic acid in the body, no longer exerted the same influence at night on a dove submitted to experiment. That bird at the ordinary night temperature would have given 0·264 grm. CO_2, but on raising the temperature to between 86° F. and 104° F., it could not be made to exhale less than 0·284 grm. This observation is very curious, especially considering that light, according to Moleschott, shows a marked influence in promoting the formation of carbonic acid and darkness in checking it. I do not find that this experiment was repeated, still, if even the only one of its kind, the result is remarkable.

We now come to the interesting experiments of Moleschott§ made in 1855, on the influence of light on the production of carbonic acid in animals. Frogs were submitted to experiment; he found that 100

* "Phil. Trans.," 1859.

† "Physiologie des Athenens," 1845, and "Brit. and Foreign Med. Review," 1846.

‡ Letellier, "Annales de Chimie et de Physique," Avril, 1845.

§ T. Moleschott, "Wittelhöfer Wiener Medicinische Wochenschrift," 1855, and "Comptes Rendus de l'Acad.," t. 41, 1855.

grms. of these animals emitted in 24 hours in the light 654 mgrms. carbonic acid, and in darkness 522, giving the proportion of 1 to 1·25, the increase of temperature accompanying the light's influence only amounted to 2°·93 C., so that it could not be considered as having exerted any influence. In another paper (same vol. "Compt. Rend.") Moleschott determines the degree of the light used in his experiments by means of photographic paper exposed for five minutes to the light, and compares the depth of tint obtained with standard colours. He finds that the carbonic acid produced under a feeble degree of light is to that exhaled under a very powerful light as 1 : 1·18, the increase of temperature being only by 1°·65 C. He concludes :—1. That frogs for similar weights, and in equal periods, exhale from one-twelfth to one-quarter more carbonic acid when breathing under the influence of light than while in the dark, so long as the temperatures are equal or vary but slightly. 2. The production of carbonic acid increases in a direct ratio with an increase of the light to which the animals are submitted. 3. The influence light exercises towards increasing the amount of carbonic acid emitted, acts partly through the eyes, partly through the skin.

Our knowledge on the influence of light upon the growth of animals, has been extended quite lately by the interesting experiments of Emile Young, of Geneva.* The favourable influence of violet and blue light on the nutrition of animal tissues is clearly demonstrated in that paper. He cites M. Béclard who, in 1858, observed that the worms from flies' eggs acquired growth in violet and blue light much more rapidly than in white and green light. Mr. Emile Young, by experimenting on frogs' eggs, observes that tadpoles become developed much more speedily in violet and blue light than in red and green light, and, moreover, that when grown in white light, and then exposed without receiving any food to the influence of coloured lights, they die soonest under the violet rays. He also states he has seen that tadpoles reared under violet light resist starvation longest if placed afterwards under white light. He concludes that violet light apparently promoted the nutrition of tadpoles more than any other coloured light. An allusion is made in his paper to the experiments of General Pleasanton, who found, by keeping young sows under violet and white glass during six months, that those under the violet glass gained, for equal weights, 34 lbs. more than those under white glass. Experiments on oxen by the same author yielded similar results.

From this mass of experimental work bearing on the influence of heat and light on animal combustion, it may be concluded :—1. That an increase of temperature causes, or strongly predisposes to a

* Emile Young, "Influence des Lumières Colorées sur le Développement des Animaux." "Archives des Sciences Physiques et Naturelles," Mars, 1879.

falling off in the production of carbonic acid, or lessens combustion in the animal body. 2. That increase of light, especially of violet and blue light (the most actinic rays), either causes, or greatly predisposes to the formation of an increase of carbonic acid, thereby promoting animal combustion.

These results do not, it will be observed, apply to the united action of heat and light, but to the influence of heat and light considered separately. They are, I fear, calculated to give us but little assistance towards a knowledge of the influence of tropical climates on the phenomena of combustion in progress in the healthy human body.

The only direct experiments and observations on that subject, with which I am acquainted, are those of Dr. Rattray, alluded to in my paper. He finds that the body loses weight in passing from a cold into a tropical climate, and regains it on its returning under a colder latitude; and, moreover, that in tropical countries the temperature of the body has a distinct tendency to rise slightly above its normal condition in temperate zones. The increased waste of tissue, and the rise of temperature of the body under a tropical sun, even should it only be trifling, appear to me to show a tendency to increased combustion in the body in a tropical climate; and the marked excess of carbonic acid I found to be exhaled under the sun of Teneriffe in July and August, over that given out near the Lake of Geneva and in the Alps, is quite in keeping with Dr. Rattray's observations.

What is the cause of this increased combustion and waste of tissue under a tropical climate? Is it the excess of the sun's heat, is it the increase of the sun's light, or is it a combined action of both? After what has been reported in this note, it must be concluded that the answer is difficult to give, and we must await further experiment to be able to explain this very interesting and important phenomenon.

So far my two communications to the Royal Society, on the influence of altitude upon respiration, have been strictly limited to brief summaries. I have not yet given the history of what has been done on that subject, otherwise I would have had many important physiological contributions to cite; these I shall propose to consider on another occasion.